

Discussion

In the final Office Action dated July 20, 2004, the USPTO rejected Claims 1 - 7, 9, 11 - 14, 16 and 18 - 20 under 35 USC § 103 as being unpatentable over Hindin, et. al., U.S. Patent No. 3,945,946. The USPTO also rejected Claims 8, 10, 15 and 17 under USC § 103 as being unpatentable over Hindin, et. al. and further in view of Shinohara, et. al., U.S. Patent No. 3,976,034. The USPTO also rejected Claims 1 - 20 under 35 USC 103 as being unpatentable over Zimmerman, et. al., U.S. Patent No. 5,378,350 taken with Hindin, et. al. and Ahlberg, U.S. Patent No. 2,374,404. Finally, the USPTO rejected Claims 1 - 7, 9, 11 - 14, 16 and 18 - 20 under 35 USC § 103 as being unpatentable over Ahlberg taken with Hindin, et. al. The applicants respectfully traverse each of these rejections.

Failure of cited references to teach the use of "eta" alumina.

In the previous response to the Office Action, filed on June 15, 2004, the applicants respectfully requested withdrawal of all rejections arguing that the use of "eta" alumina as the carrier for the catalyst of the invention was not taught by the cited references. In response thereto the USPTO asserted that Hindin, et. al. taught the use of eta alumina as it was one of the alternative forms of alumina that were mentioned therein. With regard to Zimmerman, the USPTO asserted that "[t]he use of the eta

form by Zimmerman is encompassed by the generic recitation and hence is obvious." (Page 3) With regard to Shinohara, et. al., presumably the USPTO takes the same position as it does with Zimmerman as there is a mention that the carrier may be produced from alumina without specifically suggesting any particular form of alumina. No such assertion is made concerning Ahlberg as he specifically mentions only alpha, beta and gamma alumina.

Notwithstanding these observations, the applicants respectfully assert that the selection of eta alumina as the carrier for the catalyst of the invention is not obvious over the disclosure of any of the references alone or in combination and even if it is obvious, unexpected results were achieved from the use of eta alumina as a carrier for this specific catalyst. It is well accepted that unexpected results negate a finding of mere obviousness. (MPEP 716.02) (Apparently, the USPTO acknowledges that at least one composition of the catalyst produces unexpected results by stating that a claim limited to the composition disclosed in Examples within the previously filed Affidavit would be allowable.)

The USPTO established a three step process for proving *prima facie* obviousness under 35 USC § 103 (See MPEP 2142-2143). The first step requires the Examiner to set forth the differences in the claim over the applied reference or references and explain the suggestion or motivation in the reference which would encourage a

person skilled in the art to modify the reference. (The difference is the use of eta alumina as a carrier for this type of catalyst.) The second step requires the Examiner to prove the proposed modification of the reference(s) would be likely to arrive at the claim's subject matter. The third step requires the Examiner to explain why the proposed modification would be obvious and how it teaches each claim limitation. (Thus, the USPTO must explain why the use of eta alumina is obvious when all of the evidence suggests the superiority of other forms of alumina, especially gamma alumina?)

What has been surprisingly discovered by the applicants is that the performance of this particular catalyst is optimized when a specific carrier (eta alumina) is utilized, notwithstanding the contrary teachings of the prior art. The USPTO has recognized that when a result can be optimized by choosing a specific parameter from a list of variable conditions or components, then claiming only that specific parameter overcomes a general finding of obviousness. (See MPEP 2144.05 II B). Further, when performance of that specific parameter is unexpectedly better than the prior art, further support for the patentability of that specific parameter is provided. (See In re: Antonie, 195 USPQ 6, 8 (CCPA 1977). See also In re: Boesch and Slaney, 205 USPQ 215, 218 - 219 (CCPA 1980).

In order to understand why the choice of eta alumina over the

other types of alumina is unexpected better, it is necessary to review the types of alumina carriers that are normally utilized for a dehydrogenation catalyst. Mid to high surface area gamma alumina has consistently been the preferred choice as the carrier for such catalyst, as disclosed in a number of references including Ahlberg, U.S. Patent No. 2,374,404.

In addition, a number of articles have addressed the superiority of gamma alumina as the preferred material over eta alumina for use as a carrier for dehydrogenation catalyst. For example, in Tsuchida, et. al., "The effect of Cr^{3+} and Fe^{3+} ions on the transformation of different aluminum hydroxide to $\alpha\text{-Al}_2\text{O}_3$ ", *Thermochimica ACTA*, 64, pages 337 - 353 (1983). (Copies of each article cited herein were provided to the USPTO in an IDS dated July 1, 2002.) This article states that during the formation of alpha alumina containing Cr^{3+} ions, the transformation of bayerite-containing chromium ions from eta alumina to alpha alumina was "accelerated". In contrast, the transformation of boehmite-containing chromium ions from gamma alumina to alpha alumina was "inhibited". Acceleration of transformation to alpha alumina, as is exhibited when eta alumina is heated, results in a reduced stabilization of the catalyst while inhibition in the transformation, as is exhibited by gamma alumina, enhances stabilization of the catalyst end product. The preference for gamma alumina over eta alumina is thus clear, especially because

dehydrogenation catalysts are routinely heated to high temperatures.

The preference for gamma alumina as the support material for catalysts in general, especially where enhanced stability at higher temperatures is required, is also discussed in Richardson, James T.; *Principles of Catalyst Development*, (1989). The preference for gamma alumina as a support materials is specifically discussed at pages 35 and 36, especially in a situation where a small quantity of zirconia is added to the alumina to stabilize the catalyst. This is exactly the addition made to the catalyst of the invention.

Another example of the preference for gamma alumina over eta alumina as the material to be used to form the carrier of a dehydrogenation catalyst is disclosed in U.S. Patent No. 2,943,067. At col. 5, Example 1, performance of an alumina supported catalyst produced by the Bayer process (which produces gamma alumina) is described as being superior to a catalyst prepared from a gel-type alumina, which upon heating normally converts to an eta alumina. Thus, the '067 Patent also teaches the superiority of gamma alumina over eta alumina as the carrier for dehydrogenation catalyst.

The lack of thermal stability for catalysts produced from eta alumina is also discussed in Oberlander, Richard K.: Aluminas for Catalysts-Their Preparation and Properties, page 69 (1983).

This preference for gamma alumina over eta alumina for carriers in the prior art is not surprising because gamma alumina

is generally perceived as having greater thermal stability than eta alumina. In fact, gamma alumina has become the standard alumina utilized for dehydrogenation catalyst.

Thus, it was a surprise to the applicants to discover that a dehydrogenation catalyst using eta alumina as the carrier onto which a chromium compound and a zirconium compound were added produced a superior product to a similar composition where gamma alumina was used.

It was also surprising to discover that there is a synergistic relationship between the zirconium additive and the eta alumina carrier, resulting in a surprisingly large improvement in the performance and stability of the catalyst of the invention over conventional catalysts produced from gamma alumina, chromia and zirconium. This improvement is shown by the performance of aged catalyst of the invention in a conventional dehydrogenation reaction for the conversion of isobutane to isobutylene as discussed in the Affidavit filed with the preceding Amendment dated June 15, 2004 in the table at paragraph 7. In addition, that Table also discloses an improvement in the selectivity of the eta alumina-based catalyst and an improvement in yield. Further, the catalyst of the invention was also more stable during a dehydrogenation reaction than conventional gamma alumina based catalyst.

Based on the teachings of the prior art, it was therefore

assumed that gamma alumina-based catalysts would outperform eta alumina-based catalysts. The applicants have surprisingly discovered the contrary, that eta alumina-based dehydrogenation catalyst containing chromia and zirconia preformed better than gamma alumina-based dehydrogenation catalysts containing zirconia and chromia. This surprising improvement in the performance of the catalysts of the invention is sufficient to overcome any *prima facie* case of obviousness that has been asserted by the USPTO. See MPEP 2144.09 and In re: Boesch and Slaney, 205 USPQ 215, 219 (CCPA 1980), the case cited by the USPTO in its Office Action.

Accordingly, the applicants respectfully assert that Hindin, et. al. fails to teach the preference of eta alumina as a carrier and further the surprising performance of eta alumina in comparison to gamma alumina as shown in the Affidavit of the applicant Vladimir Fridman, attached as Exhibit A to the prior Amendment clearly rebuts any finding of *prima facie* obviousness.

Further distinctions of Hindin, et. al.

To further distinguish the teachings of Hindin, et. al., clearly the primary reference, the applicants have amended each of the claims to limit the amount of the zirconium that is present in the claimed catalyst to an amount from about 0.1 to 1% by weight. (See amended Claims 1, 11, 12, 18 and 19.) Hindin, et. al. teaches that the range of the alumina should be from "about 2 to 15 weight

%.“ (See Col. 2, lines 43 - 45 and Claim 2 in Col. 4.) In fact, the amount of zirconia that is utilized in the Examples in Hindin, et. al. was 10 weight %. (See Example I, IV and Col. 13, lines 11 - 22.)) The USPTO asserts that “Hindin teaches about 2% Zr, which overlaps the claimed ‘about 1%’ due to the variation of ‘about’.” Notwithstanding, the Examiner acknowledged that a catalyst which contains only 0.7% zirconium “would be allowed”. The applicants have amended their claims to assert that the maximum amount of the zirconium is 1%, not “about” 1% as asserted in the specification. Clearly the range from about 0.1% to 1%” is not covered by the range only as low as “about” 2% taught by Hindin, et. al. The standard scientific convention teaches that “about 2%” would cover the range from 1.5% to 2.5% and would not cover the range of 0.1 to 1%. (See Viskas Corp. vs. American National Can Co., 59 USPQ 2d 1823, 1825 - 6 (Fed. Cir. 2001). Accordingly, by this Amendment, the applicants have removed Hindin, et. al. as a reference.

Finally, the applicants assert that the scope of the claims is not limited to the specific compositions disclosed in the Examples of the previously filed Affidavit. As is well accepted, Examples are not even necessary to be included with an application and merely disclose a “best” embodiment of the invention. Applicants routinely claim ranges broader than those specifically disclosed in Examples in an application. In this situation the applicants claim the range of from 0.1 to 1 % zirconium, along with the previously

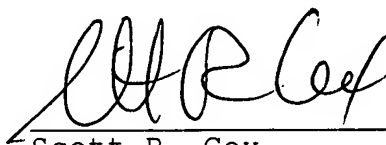
claimed range for chromium and eta alumina. The applicants respectfully assert that this new range, which is now contained in all claims of the application, is distinctive from the range of the primary reference, Hindin, et. al.

The applicants respectfully assert that the amendments to the claims are minor and do not require any new search. Further the Examiner has discussed the quantity of zirconium that would be allowed in the claims in his discussion on page 3 of the Office Action. Thus, no additional search is necessary to review this new claim limit. Accordingly, the applicants request that the proposed amendments to the claims be accepted and all claims allowed.

CONCLUSION

The applicants respectfully assert that the amended claims are allowable over the prior art and request that a Notice of Allowability be issued. If there are any additional questions, please contact the applicants' counsel.

Respectfully submitted,



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